on the same footing with the hunting-wasp, and, as to the length of its tongue, is even but little more highly developed. The assiduity with which it visits the flowers, its practice in seeking those where the honey is concealed, its well-established habit of feeding its young entirely on food derived from flowers, all place it above the average of its ancestral species. Even, however, among these ancestral species—the hunting-wasps—are certain kinds whose love for flowers has far surpassed their power of rearing a family, and these, favoured by their large size and length of tongue, have attained still greater dexterity in getting at concealed honey than Prosopis.

Out of eighty-five visits to flowers by different species, there were of Prosopis :—

On flowers with the honey apparent, 19 = 22·4 per cent.

On flowers with the honey somewhat concealed, but still fairly apparent, 19 = 22·4 per cent.

On flowers with the honey concealed, but easily reached through the formation of the mouth, 28 = 32·9 per cent.

On flowers with the honey entirely concealed, which are specially adapted to the burrowing Hymenoptera, 8 = 9·4 per cent.

On flowers without honey, or at least only having pollen as far as Prosopis is concerned, 11 = 12·9 per cent.

Some of the hunting-wasps appear to show even more intelligence than Prosopis in the search for honey, and this will appear still more forcibly if we leave out the flowers which only yield pollen, when the total result is for the wasps 35·3 per cent., for the Prosopis 48·6 per cent.

The following table will show at a glance how far the hunting-wasps are above the leaf-cutting wasps, how far the former are surpassed by Prosopis, and how far the hunting-wasps, most eager for flowers, again surpass the Prosopis.

	a	*b*	*a+b*	*c*	*d*	*c+d*	*e*	*f*
Leaf-cutting wasps	69·1	16·3	85·4	13·0	0	13·0	0	1·6
Majority of wasps indifferent to flowers	55·3	17·8	93·1	24·0	1·0	25·0	1·9	—
Principal hunting wasps ...	44·7	19·0	63·7	30·0	4·8	34·8	1·5	—
Prosopis	22·4	22·4	44·8	32·9	9·4	42·3	12·9	—
The wasps most eager for flowers	10·8	23·1	33·9	49·2	16·9	66·1	—	—

If we look down the perpendicular lines of this table from top to bottom we shall see the frequency of the visits to the flowers with the honey apparent (*a*) even if we add the visits to the flowers with the partially seen honey (*a* + *b*) steadily decline, though the visits to the flowers with partially concealed honey (*b*) steadily increase. In still more rapid ratio the frequency of the visits to the honey entirely concealed, increases (*c* + *d*), both in the case of those flowers whose honey is easily attainable through the simple form of the corolla (*c*), and those specially adapted to the burrowing Hymenoptera (*d*).

With regard to the flowers yielding only pollen (*e*), the Prosopis shows a remarkable advance on the other Hymenoptera, probably caused by the great need the young fed from flowers have of the pollen.

The results of a careful series of observations, prolonged over a course of five summers, brings us to the following conclusions :—

1. The Tenthredos stand, as regards the rearing of their young and in their general intelligence, as well as in their capacity of finding and acquiring concealed honey, the lowest of all the Hymenoptera we have considered. They visit flowers with the honey altogether apparent much more frequently than those with the honey wholly or partially concealed, and the latter only in the case of those with a low and simple organisation.

2. The hunting-wasps, which, as has been previously shown, stand decidedly above the Tenthredos, show also a decidedly higher power of finding honey. Even when the most intelligent and flower-loving families are excluded, a high percentage among the hunting-wasps is found visiting flowers with concealed honey, and a lower visiting flowers where the honey is apparent; they even seek some flowers whose formation shows them to be adapted to the fossorial Hymenoptera. All this progress appears still more remarkable when we compare the whole group of Tenthredos with the whole group of hunting-wasps.

3. Prosopis, the least highly-developed bee, and one which does not stand higher than the hunting-wasps, either in general capacity or in care for its young, is yet compelled, through the greater requirements of the latter and their need of pollen, to visit both flowers with concealed honey and flowers which only produce pollen.

4. Certain species of hunting-wasps stand above the Prosopis, both in size and in the length of the proboscis; these, however, only seek food from flowers for themselves, and not for their young.

We may now hope through the following steps to obtain some idea how the honey-bee has acquired its peculiar capacity for finding concealed honey.

All our European bees, except Prosopis and the parasitic species, have their hairy covering specially adapted to collect pollen. This apparatus forms a characteristic by which they are divided into two families, namely, those which collect the pollen with a brush on the lower side of the body, and those which collect it with the pencil-like hairs of the hind legs.

In the former family there are various degrees of development in the pollen-collecting apparatus, difficult alike to describe or distinguish; and as the relationship of these species to the honey-bee is but remote, we may content ourselves with glancing at this group as a whole.

The second group, on the contrary, offers a steady series of degrees of development which we may now compare with each other and with Prosopis.

Passing over the first step—sphecodes, we come to Andrena and Halictus, whose size and length of proboscis places them distinctly above Prosopis. Their visits to flowers rise from 7·4 per cent. in the case of flowers with the honey altogether apparent, to 51·6 per cent. to the flowers of complex form and with the honey entirely concealed.

The genera Eucera, Anthophora, and Sarapoda reach the highest point of intelligence as regards flowers of all our native bees, the length of their proboscis varying from ten to 21 mm., one of the humble-bees (*Bombus hortorum*) being the only one that can in this respect compare with them.

The three above-mentioned genera, out of fifty-six visits to flowers, paid none to those with the honey apparent, but 91·1 per cent. to those with either concealed honey of complex form, or with both characteristics united.

There is no further example of increased development of the proboscis in this family, but they have attained a further step in the transformation of the thigh brushes into pollen-baskets, and above all in the establishing the community of life and of labour which distinguishes the humble hive bees. From observations made on the latter, however, it appears that increased development shows a certain return to the flowers containing more visible honey, the honey bee, out of 520 visits observed, going to such flowers at the rate of 0·8 per cent., the hive-bee, 194 visits being observed, at the rate of 3·1 per cent.

The following table is fuller than the previous one :—

	a	*b*	*a+b*	*c*	*d*	*c+d*	*e*	*f*	*g*
Tenthredos	69·1	16·3	85·4	13·0	0	13·0	0	—	1·6
Hunting-wasps	44·7	19·0	63·7	30·0	4·8	34·8	1·5	—	—
Solitary bees ... ... / Prosopis	22·6	22·6	45·2	33·3	7·1	40·4	11·9	2·4	0
Andrena and Halictus	7·4	26·5	33·9	40·2	11·4	51·6	9·6	2·0	2·9
Cœlissa ... ... / Panurgus, Dasypoda / Rhophites ... ... / Halictoides	0	9·6	9·6	65·4	17·3	82·7	5·8	0	1·9
Eucera Anthophora ... / Saropoda	0	5·4	5·4	5·4	85·7	91·1	3·5	0	—
Osmia Chalciodoma... / Diphysis, Megachile	0·5	10·1	10·6	27·4	43·7	71·1	13·0	3·4	1·9
Social bees ... ... / Bombus apis	0·8	8·3	9·1	26·3	55·6	81·9	4·0	4·8	0·2
	3·1	15·5	18·6	25·3	34·5	59·8	13·4	7·2	1·0

Explanation of Table—

a, flowers with honey apparent; *b*, partially apparent; *c*, honey concealed but easily reached; *d*, concealed but adapted to a short proboscis; *e*, flowers only possessing pollen; *f*, useless attempts to get honey by making a hole, as on Dielytra; *g*, flowers without honey.

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The visits to the flowers with partially apparent honey $a + b$ steadily diminishes from the Tenthredos to Andrena and Halictus, but so that the diminution of the visits entirely refers to the flowers with the honey apparent, while, on the contrary, the flowers with honey partially hidden are visited with still greater frequency.

In the case of some solitary bees, the disinclination to flowers with the honey apparent has reached to their total abandonment.

The transition to social life brings the development in the second group, of which we have been treating, to an end, as, in proportion as the number of individuals in a community increases, the necessity for food forces them to seek honey where they can, and it is indeed touching to see the unwearied diligence with which the hive-bee will collect almost imperceptible drops of honey from even the smallest flowers.

The perfection which the family of bees, viewed as a whole, has attained, beginning with Prosopis, and rising to the most perfect of the solitary bees belonging to the group which collect pollen on their hind legs, consist :—

1. In the increasing development of the pollen-bearing apparatus.
2. In the prolongation of the lower part of the mouth.
3. In the increasing size of the individuals.

The first is seen best in the humble and hive-bees ; the third is very marked in the humble-bee, while the length of the proboscis reaches its furthest point in Anthophora. The hive-bee has a more perfect pollen apparatus than the humble-bee, but is inferior to the latter in size and length of proboscis, and only succeeds in obtaining more honey through its more populous communities.

It is well known that as a rule every hive-bee occupied in seeking food from flowers specially devotes itself to a particular species, passing by others, however rich in pollen or honey. The advantages of this arrangement are obvious, much fewer visits being made in vain to flowers already plundered, and much greater dexterity being attained in the case of flowers with complex forms.

Two questions remain to be decided—

1. Does each individual bee collect pollen and honey from a single plant only (to which it has become adapted by instinct, *i.e.*, by inherited custom)?

2. Does the hive-bee possess a greater degree of intelligence in deciding among the different species of plants than the humble-bee and other lower forms ?

The first question must be met with a decided negative ; the second, as far as observation has yet gone, cannot be answered with certainty. It would scarcely be of advantage to the bee-community, whose object is the exploitation of as many flowers as possible, if its instincts as to special tribes were hereditary.

It is, on the contrary, to be observed in the hive-bee that each bee makes various essays before deciding on any special tribe of flowers. For example, we have seen a hive-bee in vain attempt to obtain the honey of *Iris pseudacorus*, and then fly to *Ranunculus acris*, which it sucked at for some time. Another more than once bored through the spur of *Orchis latifolia*, loading its head with two little clubs of pollen, and then flying to the flowers of *Lychnis floscuculi*.

A third, wandering over a field full of weeds, visited one after another *Veronica hederæfolia*, *Lithospermum arvense*, *Sisymbrium thalictrum*, and *Viola tricolor*.

These and similar facts show that there can be no question of inherited preferences for certain plants in individual bees, and that the fact of each bee being devoted to certain plants is only to be ascribed to the subordination of the interests of the individual to that of the state. The humble-bee approaches the hive-bee in the peculiarity of keeping to certain species, as well as in the number and keeping of its community. However, though chiefly confining itself to the plants accessible to it alone, as for example, *Lamium album*, &c., there are fairly numerous cases in which the humble-bee goes to other plants, and its baskets are often found full of very varied kinds of pollen.

Even in solitary bees, the special preference for special kinds of flowers is a frequent habit. For example, *Andrena hattorfiana* is found on *Scabiosa arvensis*, *Cilissa melanura* on *Lythrum salicaria*, &c. ; but this preference evinced by some solitary bees for a single species of flower sufficing all their needs is radically different from the practised and exhaustive pillage of all flowers by a bee community, in which special individuals are told off to gain the produce, however small, of special families of plants. At first I believed I could answer the other question propounded above, *i.e.*, whether the hive-bee promises a higher degree of intelligence in distinguishing different genera of plants than the humming-bee and other lower forms, in the affirmative, on the ground of the following observations :—In a field grown over with weeds I saw one of our more intelligent humble-bees, *Bombus agrorum*, visit without distinction the little whitish flowers of *Viola tricolor* var. *arvensis*, and those of *Lithospermum arvense*, the same size and colour, but evidently differing in form, while avoiding all other plants. I had, indeed, seen the hive-bee mistake the flowers of *Ranunculus arvensis* for those of *R. bulbosus*, those of *Trifolium repens* for those of *Trifolium fragiferum* many times, but had then never seen it make so great a mistake as that I have recorded of the humble-bee. From this I concluded that the hive-bee is more practised in distinguishing various species than the humble-bee. As, however, I later saw the hive-bee go from the blue violet to a hyacinth of the same colour, and back again, I felt convinced that the grounds of my conclusion were somewhat defective, and I can only leave the decision of this question to further observations. As far as my own experience is concerned, I am inclined to believe that the hive-bee, as well as all other bees which we see preferring special families of plants, are much more led by colour and size than by any clear apprehension of the form of the flowers.

A. J. G. D.

AN ACCOUNT OF DUPLEX TELEGRAPHY

THE introduction of the duplex system of working not only upon land-lines, but on sub-marine cables, is without doubt the most important advance recently made in electric telegraphy.

Duplex telegraphy may be defined as the art of telegraphing in opposite directions simultaneously along one line wire.

It is claimed by M. Zantedeschi in papers read before the Academy of Sciences, Paris, in 1855, that as early as 1829 he had suggested and demonstrated the possibility of working "duplex ;" but until the year 1853 there do not appear to have been any noteworthy attempts made to effect it practically. In that year, Dr. Gintl, a director of Austrian telegraphs, described a system of duplex telegraphy to the Academy of Sciences, Vienna, and practically tested it on the land-lines between Vienna and Prague.

The principle underlying this and all other systems, is that the outgoing currents at a station shall not sensibly affect the receiving instrument there, while, at the same time, the latter is free to be affected by the incoming currents, so to speak, from the other station. That is to say, no signals are made at a station by its own sending currents, unless when these are interfered with by the sending currents of the other station.

Gintl's plan was as shown in Fig. 1. The receiving instrument, R I, was wound by two separate wires, one long and thin, the other short and thick. The long wire, shown by a full line, was connected at one end to the line L, and the short wire, shown by a dotted line, was connected at one end to a local, or, as it was called, a "com-

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of a temporary submergence to spread out the *débris* with such uniformity. During the retreat of the waters, pluvial action might perhaps wash away the softened soil in the regular manner described. ALFRED R. WALLACE

The Number of Species of Insects

PROF. HUXLEY is very much within the mark when he estimates the species of insects at "about 100,000, if not more." Were I to estimate the number of described species at 200,000, I believe the figures would also fall short of the truth, even allowing a liberal margin for synonyms. In one order alone (*Coleoptera*) it is estimated that 80,000 species have been described.

I could enlarge upon the bearing these figures have upon theories on the geographical distribution of animals, but content myself with the remark that the groups of insects selected by writers on the subject are those in which colour is most prominent and structure least differentiated.

Lewisham, January 12 R. MCLACHLAN

[WE sent the above to Prof. Huxley, who has appended the following note.—"It was not my object to give an accurate estimate of the total number of species of insects. Gerstaecker, in the new edition of Broun's 'Thier-reich,' gives 200,000 as the total number of species of *Arthropoda*; but I dare say that Mr. McLachlan has good grounds for the claim he puts in for insects alone. "T. H. HUXLEY"—ED.]

Meteor

PRECISELY at 6 P.M., on the 19th inst., I saw a splendid meteor traverse the sky from a point about midway between Orion's belt and the Pleiades to a point directly under the moon, and about 10° above the horizon. It was pure white and dazzling, lasted about five seconds, emitted no sparks, except at the moment of disappearance, and was about half the size of the moon at the time. R. M. BARRINGTON

Bray, Co. Wicklow, January 21

Diurnal Barometric Range at Low and High Levels

YOUR notice under this head (vol. xv. p. 187) of my paper on the daily inequalities of the barometer at Mount Washington and Portland, Maine, has hit a blot of which I was unconscious until now. Had I been more than a student writing one of his first essays in meteorology, I should probably, like yourself, have suspected something wrong in the Portland curve. The morning maximum and the afternoon minimum, as you point out, occur very much earlier than is usual.

Differences varying from +0·027 inch to −0·004 inch between your averages of General Myer's figures and those given in my paper did not surprise me, as mine were intended to represent the temperature of 60° F., while you have probably taken the observations either as already reduced to 32°, or have yourself reduced them to this temperature. My own impression is and was that the printed observations are not corrected for temperature, and in order to make the comparison with as little change as possible in the original figures for the three stations I brought each to something near a mean temperature for the three attached thermometers. Unfortunately, and here comes the blot, I now find that, by some mischance, in taking out the differences for Portland the external temperatures were taken instead of those by the attached thermometer. I exceedingly regret this, and shall as early as practicable make the required correction.

Fortunately this error does not affect the purport of my paper or the suggestions which I offer in it towards the explanation of the long-vexed question of the cause or causes of the daily inequality of the barometer.

An acquaintance with the variations of the daily barometric curves, which depend on change of season and difference of locality, would undoubtedly be of assistance in drawing these curves when the observations for only a few hours are given, but the six hours for which the Portland figures are given are so well distributed as to leave little uncertainty as to the general form of the curve in this case. I should not, however, be satisfied with any curve for the Portland observations which, when analysed by the usual formula and reconstructed from the co-efficients thus obtained, did not reproduce the original observations, and also the interpolated values for the other hours, within a limit of error of 0·001 inch. Unless your curve can stand this test I shall not be satisfied with your deductions as to the epochs of maximum and minimum values. Having had much experience in drawing such curves, I venture to assert that the Portland observations, whether taken as they are printed or after a correction for temperature, will still give the morning maximum and afternoon minimum of the barometer much earlier than is usually the case in this country. If my paper draws attention to any singularity of this kind it will mitigate the disappointment caused by the mistake in the temperature correction.

I append the times of maxima and minima for Portland, May, 1872, as corrected; also similar data for five years at the Naval Observatory, Washington, U.S., and for Oxford, England.

Times of Daily Maxima and Minima of the Barometer for the Month of May.

	First Min.	First Max.	Second Min.	Second Max.
Portland, Maine:—	h. m.	h. m.	h. m.	h. m.
1872	1 30	7 30	15 30	21 20
Washington, U.S.:—				
1862	1 30	9 0	17 30	22 40
1863	1 30	8 20	17 30	22 40
1864	1 20	10 10	17 0	22 0
1865	1 50	9 0	16 0	22 30
1866	1 20	8 30	17 0	21 30
Mean for five years	1 30	9 0	17 0	22 16
Mean from calculation as given by Prof. J. R. Eastman ...	2 0	8 0	16 50	22 20
Mean for sixteen years at Oxford, England	3 55	7 55	16 25	22 45

Liverpool, January 5 W. W. RUNDELL

Former Climates

IT appears to be established that a climate favourable to the growth of coal plants and coral builders has prevailed in latitudes where the sun now shines for about seven months out of twelve.

Without inquiring how it came about that a warm sea once washed polar coasts, it would be interesting to learn whether the plants and animals concerned in the production of coal forests and coral reefs can flourish under these conditions of light supply.

Holmwood, Putney Hill D. PIDGEON

Tape-worms of Rabbits

HAVING had occasion to dissect a number of wild rabbits, I have been surprised to find that the majority of them are infested with a large species of tape-worm. Can any of your readers inform me whether the life-history of this parasite has ever been made out? The case appears to be a remarkable one, because the host cannot here be suspected of ever taking animal food. Unless, therefore, we suppose that the tape-worm of a rabbit differs from other tape-worms in not passing through a hydatid stage, it becomes difficult to explain the very general occurrence of this species. GEORGE J. ROMANES

POLARISCOPE OBJECTS

THE following is an interesting combination:—When the polariser and analyser are crossed, insert a concave plate of quartz cut parallel to the axis, with its axis inclined at 45° to that of the polariser, add to this a quartz wedge cut also parallel to the axis, having its axis placed perpendicular to that of the concave plate. The coloured circles, shown by the concave plate alone, will be seen to be displaced in the direction of the thicker edge, to a distance dependent upon the angle of the wedge. Also, as the wedge is made to slide in or out, the circles will be seen to expand or contract, according as the thicker or thinner part of it is presented to the field of view.

The explanation of this is to be found in the fact that a combination of two crystalline plates is optically equivalent to a single plate, whenever the axes of the plates are either parallel or perpendicular to one another. This follows immediately from a comparison of the mathematical expressions for the intensity of the light at any

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bringing water, but its position in Teneriffe during summer is favourable for making it deposit any which may be present."

I think from these extracts, which are supported by other passages in Prof. Smyth's work, I am quite justified in arguing that the trades and counter-trades are not similar in their constituents, that their degrees of electricity and of saturation are not the same, and that therefore it is not reasonable to suppose that their upper currents intermingle at the belts of tropical calms, and that their mixed volume descends and is then drawn off north and south as required, to restore the equilibrium of the atmosphere.

As these opposite currents flowing in the northern hemisphere from the north-east and the south-west (approximately) do not intermingle, and their mixed volume does not descend in the calms of Cancer it must necessarily follow that the south-west or return equatorial current, does descend to the surface of the ocean on the polar side of the calms of Cancer, and equally that the north-east upper current does descend on the equatorial side.

I have by no means exhausted what I have to say on this subject, but Mr. Ley will doubtless understand that I am unable to treat it at greater length in your columns. The same line of argument would have enabled me to answer Mr. Ley's questions separately had space permitted. DIGBY MURRAY

Mind and Matter

PERMIT me to correct a mistake on the part of Mr. Tupper (NATURE, vol. xv. p. 217), who, though starting with a correct notion that my letter (NATURE, vol. xv. p. 78) was intended to solve a problem, immediately fell into the error of regarding it as intended to prove an alleged fact.

The fact alleged, that consciousness depends on nervous organisation I assumed to be a fact, and undertook to indicate *how* the dependence might be conceived, or regarded, to exist.

First, I alleged that the hypothesis of matter being as susceptible of consciousness as spirit, was quite *conceivable, as a hypothesis*, whether or not it should be proved afterwards to be a wrong hypothesis.

Second, the connection of two so dissimilar entities as matter and subjectivity had not the objection of being anomalous or unique; for energy and matter were equally dissimilar and yet invariably united. The parity of mystery was not intended to establish "parity of probability as to the facts." but merely *parity of conceivability*. For it is surely some help to our entertaining a new conception if we can point to an existing similar conception.

Third, if such a mysterious entity as energy could be divided and combined (using the words in a loose sense) why should there be a difficulty in conceiving of the division and combination of subjectivity. By this I meant that as division of matter involved division of energy, as to *amount*, so division of matter might be conceived involving division of subjectivity, as to *amount*: so with combination.

Thus far, however, I had only cleared away difficulties "real or apparent" in the way of our *conceiving* the relation of consciousness to matter from the "materialistic" stand-point.

The essential part of my solution which indicated roughly the *modus* of the connection between matter and consciousness and which dealt with the great difficulty of the question—How to account for the *two* aspects of matter, the unconscious and conscious?—has not been touched by Mr. Tupper. This portion he excused himself from examining because he regarded it as based on the assumption that "the probability of subjectivity being a property of matter equals the fact of energy being related to matter," whereas it is based on the fact, or alleged fact, or assumption, that "the dependence of consciousness on nervous organisation seemed by the science of nerve-physiology to be fairly established." To mistake allegations of the conceivability of a notion for assumptions or intended proofs that the notion is true, as has been done by Mr. Tupper, is surely not equivalent to pointing out fallacies in the solution of a problem.

Will he admit that, if a "pointer" could "tell us" he scented a fox and immediately thereafter follow the scent of a hare, such would be an admirable analogy of how to practise "sound logic by the old *à priori* method?"

Stafford, January 17 W. S. DUNCAN

Pre-Glacial Man in America

DR. ABBOTT, in his interesting letter on the traces of pre-glacial man in America, supposes that it may be correct that the American aborigines migrated from the Old World. This may be the case with the Red Indians, but we know that they drove out an earlier people—the mound-builders. However, both mound-builders and Red Indians were certainly post-glacial in their occupation of the northern parts of America, and the oldest traces of their existence may not date back to an earlier time than a late stage of the Neolithic period in Europe.

Palæolithic man in America holds the same relative position to these later peoples as he does in the Old World, and we have so far obtained no evidence to show whether he occupied Europe or America first. The position of his remains in the auriferous drift of California is the same as in that of Siberia; in the löess of the Mississippi as in that of the Danube and the Rhine; in the caves of Brazil along with extinct mammalia as in those of Europe; and in the lowland gravels of Virginia as in those of France and England.

The question of the post or pre glacial age of palæolithic man depends in America as it does in Europe on that of the age of the deposits in which they are found, and this is at present a matter of inquiry and discussion which might be set at rest, as I have pointed out in the *Quarterly Journal of Science* for July of last year, by a thorough examination of the brick clays at Hoxne where palæolithic implements were first found in England.

Cornwall House, Ealing, January 27 THOMAS BELT

Holly Berries

REPORTS of the scarcity and abundance of holly berries have appeared in NATURE from the south-east of England and west of Scotland respectively. It may be interesting to note the condition of the holly crop at a point somewhere about midway between these two places. In North Staffordshire and Derbyshire the holly berries are by no means scarce. They are not so plentiful as they were last year, but there is a fair average crop.

I have seldom seen such crops of them as I saw in several places in South Wales about a month ago. It may be also worth adding that the most teeming bush I saw was at a place in Cardiganshire, which was as far as I could learn—and I made diligent inquiries—between four and five miles from the nearest hive of bees. I questioned closely several children on the spot who were intelligent enough to give me a minute description of most of the common birds and insects; not one of them had ever seen a bee. D. EDWARDES

Denstone College, Staffordshire

The Meteor of January 7

AMONG the "Notes" in NATURE, vol. xv., p. 244, there is a description of a large meteor, of which I was fortunate enough to secure a good observation; but on comparing the apparent path, as observed by myself, with that recorded in the paragraph, I find the latter somewhat imperfect; the apparent path, as seen from near London, seems to have been curtailed both at beginning and at end of flight; probably the observer in question could further amplify his remarks, or some other correspondent send an observation. The following is an abstract from my note-book:—

"Birmingham, January 7, 10·31 P.M. G.M.T.—Meteor pear-shape, deep yellow merging into ruby-red towards the tail; commenced as a luminous point near η Hydræ, gradually increased in size, motion very slow and unsteady, appeared to force its way with difficulty, and slight undulation. Near α Leonis it attained the apparent size of Venus, the forward hemisphere now showing signs of internal commotion by the projection of ebullition prominences, which were swept back towards the tail, then 8° long, and vaporous. The latter portion of its flight was intercepted by houses, but on emergence it burst with a flash below β Leonis at A.R. 182°, D.N. 16°. Length of path, 52°; time of flight, five to six seconds; radiant point (in Fluvius Eridanus), No. 96 Tupman, or No. 164 of the B. A. Catalogue. W. H. WOOD

Balsall Heath Road, Moseley Road, Birmingham

Spectrum of New Star

THE spectrum of the new star in Cygnus is changeable, and is now very unlike Cornu's representation of it in a recent number of NATURE (vol. xv., p. 158). Your readers may not be aware that it is easy to see several of the bright lines without a powerful instrument, though not to measure them accurately. As observed with a Browning's "miniature spectroscope" attached to a 4¼-inch refractor, the brightest line is now about at

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Now, while these sounds were audible to human ears, it may be fairly believed that they would have been readily detected by the woodpecker, which may be often observed to halt suddenly on its way up a pine trunk. This *trait* in the mode of climbing is noticeable more or less in all the insectivorous climbers, and appears to me to be caused partly by the bird listening for the sounds produced by insects either in the bark or in the wood. I noticed this particularly in the case of the great black woodpecker (*P. pileatus*) or "log-cock," as it is named in Canada. It would suddenly stop on its way up a tree trunk, and after remaining perfectly motionless for a short time, commence to attack the bark and wood with great vehemence. Every one who has travelled in North American forests will have observed how the excavations made by woodpeckers are often confined to one side of a tree, or to particular situations. And not only on decayed parts, but, as in the case of the extremely tough cedar (*T. occidentalis*), where openings of several inches in circumference have been made through several inches of perfectly fresh wood in order to reach the decaying central layers where wood-eating beetles deposit their eggs and the animal is matured. Admitting that it may have been induced to dig out the insect by tracing the external opening inwards, still in the case of the larvæ the wandering from its birth-place, and the sounds consequent on the tunnelling process, would assuredly be heard by a bird whose ears had been trained to such delicate noises through the necessities of its mode of life. I can therefore well believe that auscultation is of great service to such birds, and also to nocturnal species in discovering their prey. A. LEITH ADAMS

Royal College of Science, Stephen's Green, Dublin

Tapeworm in Rabbits

I WOULD suggest that the tapeworm referred to by Mr. G. J. Romanes is like the Bothriocephalus of man—perhaps a species of the same genus. This is not supposed to have a cystic state, but to be developed from a ciliated embryo taken into the system on raw or badly-cooked vegetables, which have been watered by sewage from cesspools, in which the eggs will remain alive for months.

In the same way the eggs of the rabbit's tape-worm probably remain in the animal's droppings till set free in rain as ciliated embryos. As the rabbit feeds on the vegetation watered by such rain, there is no difficulty in understanding how the embryos would reach his alimentary canal. R. D. TURNER

Meteor of January 7, 10.31 P.M.

THE fine meteor mentioned in NATURE, vol. xv. p. 244, and also seen by Mr. W. H. Wood, p. 295, was observed by many other persons; and as your correspondent asks for another observation of it, the following may be useful:—"J. L. M'C.," writing from Putney Hill, London, says: "As near as I could judge, it appeared between the stars Castor and Pollux (α and β Geminorum), and its course lay almost due north-east, passing over the stars λ and ψ Ursæ Majoris, and disappearing a little beyond the latter star. It was of great brightness, left a tail of fire in its wake about two degrees in length, and was visible some ten seconds." This account, compared with the other two referred to, stands as follows:—

Place.	Meteor. Begun R.A.	Begun Decl.	Ended R.A.	Ended Decl.	Length of path.	Duration in seconds.
London	153°	+ 43°	200°	+ 31°	39°	Very slow.
W. H. Wood, Birmingham	130	+ 5	182	+ 16	52	5½
J. L. M'C., Putney Hill, London	113	+ 31	170	+ 46	46	10

From these paths the radiant point comes out near γ Eridani, R.A. 58°, Decl. S., 12°, and I can confirm this position from other meteors seen in January, including one as bright as Venus, on the 4th, 8.51 P.M., which exhibited the same slow, halting motion as that noted in regard to the fine one seen on the 7th. I have read other accounts of the latter, but they are mostly vague. At Bermondsey it was seen at 10.30, and described as large and remarkably brilliant, closely resembling in size and colour the meteor which appeared on September 24, 1876. It was of a bluish colour, left a long tail or streak of light in its wake, and its course in the heavens was from south-west to north-east. At 10.37 on the same evening a very large, brilliant meteor was seen at Lower Clapton, and this, no doubt, refers to the same object.

Mr. Barrington (NATURE, vol. xv. p. 275) notes another bright meteor, at 6 P.M., on January 19, but its apparent path shows it to have been different to the one seen by a correspondent at Wolverhampton, at 6.27, January 19, who writes that he witnessed a meteor of "unusual magnitude and brilliancy. It moved almost perpendicularly, in a southerly direction, very slowly, the time occupied in its passage being about seven or eight seconds."

Ashley Down, Bristol W. F. DENNING

THE UNITED STATES GEOGRAPHICAL AND GEOLOGICAL SURVEY OF THE WESTERN TERRITORIES UNDER DR. F. V. HAYDEN

Explorations in 1876.

WE have been furnished with some early notes upon the results of the work of Dr. Hayden's survey during the past year, from which we make the following extracts:—

"For reasons beyond the control of the geologist in charge, the various parties composing the United States Geological and Geographical Survey of the Territories did not commence their field-work until August. Owing to the evidences of hostility among the northern tribes of Indians, it was deemed most prudent to confine the labours of the survey to the completion of the Atlas of Colorado. Therefore the work of the season of 1876 was a continuation of the labours of the three preceding years, westward, finishing the entire mountainous portion of Colorado, with a belt of fifteen miles in width of northern New Mexico, and a belt twenty-five miles in breadth of Eastern Utah. Six sheets of the Physical Atlas are now nearly ready to be issued from the press. Each sheet embraces an area of over 11,500 square miles, or a total of 70,000 square miles. The maps are constructed on a scale of four miles to one inch, with contours of two hundred feet, which will form the basis on which will be represented the geology, mines, grass, and timber lands, and all lands that can be rendered available for agriculture by irrigation. The areas of exploration of the past season are located in the interior of the continent, far remote from settlements, and among the hostile bands of Ute Indians that attacked two of the parties the previous year."

The force was divided by Dr. Hayden into four parties. The first, for primary triangulation, under Mr. A. D. Wilson, with Mr. Holmes as artist and geologist, accomplished the survey of an area of about 1,000 square miles. The second, or Grand River party, under Mr. Garnett as topographer, and Dr. Peale as geologist, surveyed about 3,500 square miles. The third, or White River Division, with Mr. Chittenden as topographer, and Dr. Endlich as geologist, spent forty-eight days in absolute field-work, and reports a surveyed area of 3,800 square miles, in the accomplishment of which 1,000 miles of traverse were made, while forty-one main topographical stations and sixteen auxiliary ones were established. The fourth, or Yampah party, conducted by Mr. Bechler, topographer, assisted by Dr. White, geologist, surveyed about 3,000 square miles. Thus, during the two months of last autumn, these active explorers surveyed about 11,300 square miles of territory (that is more than the whole of the southern or lowland part of Scotland) with sufficient accuracy and detail to permit of the construction of a general map on this scale of four miles to an inch, and with contour lines at successive elevations of 200 feet to mark the main topographical features. Fortunately the geological structure is of extreme simplicity, otherwise such rapid and useful work would be impossible. Dr. Hayden and his associates are doing good service by making known in this way the main features of those vast territories, leaving the details to be worked out at a later time.

Among the most interesting geological results obtained last year are some additional particulars regarding the brackish water-beds lying at the base of the tertiary rocks of these western territories. Three new species of

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regions into the higher latitudes, and the polar air brings the less rotatory velocity of the polar regions into the lower latitudes. The latter constitute the trade-winds, which move more slowly than the earth's rotation, and consequently appear as an atmospheric current from the east; the former constitute the "counter-trades," which move more rapidly than the earth's rotation, and appear as an atmospheric current from the west.

The centrifugal force of the "counter-trades," as they circle round the poles, is the cause of the polar depression of the barometer.

The law of reaction makes it impossible for the earth's rotation to be either accelerated or retarded by the winds, and consequently the entire "torsional force" exerted by the winds on the earth must, at any given time, be equal in the easterly and westerly directions.

I have now described in outline what theory shows that the circulation of the atmosphere would be in the absence of watery vapour and in the presence of the sun's heat and the earth's rotation; and observation shows that such is the actual circulation on the large scale, and not taking account of local disturbances. JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, February 23

Halo round Shadow

IT is not uncommon for an observer, when looking at his own shadow on rough ground or turbid water, to see its head surrounded by a halo, of which the brightest part is in contact with the shadow.

This phenomenon has often elicited notice, but as far as I am aware has not before now been explained, nor do those who have mentioned it seem to have observed that its appearance depended on the nature of the surface receiving the shadow.

The conditions necessary for the production of these halos are—

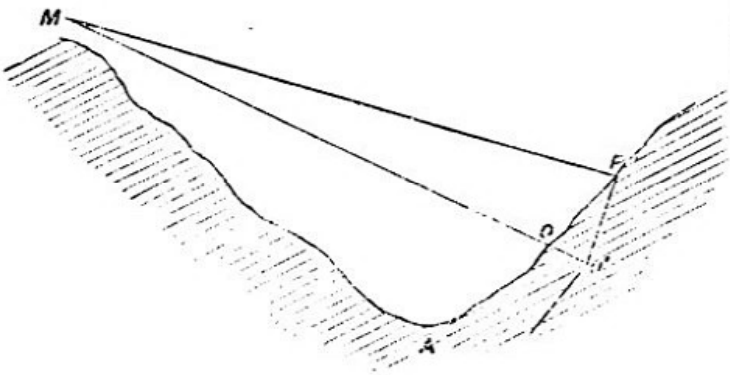
1. That the screen, as whatever the shadow is cast on may be called, should not be a continuous surface, but a number of small surfaces with intervals between them, each of these small surfaces of course casting its own shadow on whatever happens to be behind it.

2. That the shadow should be at a considerable distance from the observer.

3. That the light should not fall very obliquely on the screen.

The first of these conditions only is essential, but the fulfilment of the last two makes the phenomenon more marked.

Rough grass forms a good screen, especially if, as in the diagram, conditions 2 and 3 are fulfilled by the shadow being



cast on one side of a valley, while the observer is standing on the other.

In the case of the shadow on turbid water, it must be remembered that it is not the surface of the water which forms the screen, but the particles suspended in it.

The general explanation of these halos is this—

From the observer's point of view the screen in the immediate neighbourhood of the shadow of the head is seen in nearly the same direction as it would be from the source of light. In this direction, therefore, each of the small surfaces of which the screen is made up will hide its own shadow, but this will be true of no other direction; and the effect on the whole will be that the screen will appear brighter close to the shadow of the observer's head than elsewhere.

To examine this rather more in detail, let M A O be a section of the ground passing through the observer at M and his shadow at O. Let

$$O'P = r \quad O'MP = i$$
$$O'PM = \text{a right angle.}$$

Let w and w' be the projections on o' P of the average breadth of the sections of the small surfaces made by the plane M A o, and the average distance between them respectively, and let h be the average distance of each of the small surfaces from its own shadow.

Then the amount of light received from any space $r\,d\theta\,(w + w')$ may, *cæteris paribus*, be taken without any great error as a measure of the brightness of the zone whose mean radius is r, and whose breadth is $w + w'$ ($d\theta$ being a small rotation of r about o' M), and this will be proportional to $w + w' - h \sin. i$, The decrease in brightness is proportional to h and sin. i, and will reach a maximum when $h \sin. i = w$, if $w < w'$, or $= w'$ if $w' < u$.

Outside the circle defined by this value of i the brightness will be sensibly constant, because the quantities of which w, w' and h are the average values have all manner of actual values, even in a very small space.

These expressions are only approximate, but they serve, as well as the longer exact formulæ, to show the general laws of the phenomenon. ARNULPH MALLOCH

Meteor

THIS evening, at close upon twenty minutes past six, as I was walking in my garden towards the almost full moon (which was very bright), I observed a brilliant meteor pass from right to left over, and very near, the moon's disc. It was visible for a distance of about twice her diameter. From the amount of daylight, and the extreme brightness of the moon, I judge this meteor to be worth recording. C. M. INGLEBY

Valentines, Ilford, February 26

Tape-worm of Rabbits

So far as I am aware the only evidence in favour of the view that *Bothriocephali* present no hydatid stage is that which has been furnished by the researches of Knoch. To me it has always seemed that this evidence is insufficient fully to overcome the analogical probability that tape-worms of this genus resemble tape-worms of other genera in passing through a hydatid stage—and this notwithstanding the occurrence of a ciliated embryo. However, in my previous letter I ought no doubt to have alluded to the researches of Knoch, and should certainly have done so had my object in writing been other than it was, *i.e.*, merely to ascertain whether anyone had as yet taken the trouble to trace the life-history of the rabbit's tape-worm.

February 20 GEORGE J. ROMANES

A PROBLEM IN THE NATURAL HISTORY OF THE SALMON.

MR. FRANK BUCKLAND, in giving evidence before the Parliamentary Committee, which during last session of Parliament inquired into the condition of our oyster fisheries, stated that "a salmon (? *Salmo salar*) does not breed every year, but every three years!" On being asked by a member of the Committee if he had any proof of his averment, Mr. Buckland stated that, "he had a great idea of it," but was deficient in proof. Before examining this alleged fact in the life of the salmon, advanced by Mr. Buckland, it is proper that we should state briefly what induced him to make known his idea.

While illustrating the theory of oyster spatting, and telling the Commissioners that all the individual oysters on a *scalp* would not be found exuding their young at the same time, however favourable for spatting the period might be, Mr. Buckland also enunciated his opinion as to the periods at which salmon spawn. That gentleman holds that only one of every six oysters on a *scalp* will be found in a procreant state during the same season; and, by way of clenching his illustration, he said, "you never get salmon always breeding the same year, they take time to recover themselves, and so forth." This latter state-

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The Estimation of Urea by means of Hypobromite

ALLOW me to correct a slight mistake into which your reporter has fallen, no doubt inadvertently.

Knop was the first to propose (in 1870) the use of a strongly alkaline solution of hypobromite for the estimation of urea in place of the hypochlorite previously employed by Davy. Every chemist who since 1870 has worked with the process has, as far as I am aware, retained the exact composition of Knop's hypobromite solution.

The modifications in details which I have proposed are therefore for the purpose of facilitating the working of Knop's process. This process is, I believe, the one best suited for general use. Certainly no other process as yet devised equals it in rapidity and ease of working, and few, if any, surpass it in accuracy. If, then, it should be deemed desirable to attach any names to this process, I would suggest that it be called the Knop-Davy process. A. DUPRÉ

Westminster Hospital, February 24

Colœnis Julia in Texas.—Venomous Snakes devouring each other

IN Chapter xv. of his "Geographical Distribution of Animals," Mr. Wallace mentions *Colœnis* (belonging to the Nymphalidæ) as one of the South American forms, which do not pass north of Costa Rica or Nicaragua. I have taken, though only once during nine years, a female of *Colœnis julia*, Hübner, here at Bastrop, on the Colorado, in about 30° N. latitude, but I believe this to be the first time where said species has been captured in temperate America.

I do not know whether the fact has been observed before, that one venomous snake will devour another belonging to even the same genus. Some time ago I captured, on the Guadaloupe River, a large and very thick *Ancistrodon pugnax* (Water Moccasin), one of the Crotalidæ, and upon opening it, found inside a large and quite well preserved specimen of *Ancistrodon contortrix* (Copperhead).

Although I have examined many venomous snakes since, I never found a similar case, and the stomachs contained only mice, frogs, &c. L. HEILIGBRODT

Bastrop, Texas, February 7

Lowest Temperature

THE temperature experienced during the night between February 28 and March 1 was so exceptional, that it may be thought worthy of a passing remark. The minimum reading at this observatory was 9·1° F., which is the lowest recorded during the last sixteen years; that of December 24, 1860, was, however, lower, being 6·7°. The lowest readings for February and March during the past twenty-eight years were respectively 10·1° on February 1, 1855, and 14·5° on March 4, 1866.

Stonyhurst Observatory, March 2 S. J. PERRY

Meteor

I SAW the meteor described by Mr. Ingleby on February 26, about 6.20 P.M., Greenwich, from the railway platform at Gloucester. It was moving very slowly from right to left parallel with the horizon to the right of the moon, and a good deal below her; I should think two or three degrees at least. A bright track was left behind. The size must have been considerable for it was a very brilliant evening, and still almost daylight. No stars were visible in that part of the sky. I could not then see the position of Sirius, however. It was tolerably bright twenty minutes later. Gloucester is nearly due west of Ilford, and about 100 miles distant in a straight line.

Westbury-on-Severn, March 3 ALBERT J. MOTT

REPORT ON THE GOVERNMENT METEOROLOGICAL GRANT

THE following is the Report to the Lords Commissioners of her Majesty's Treasury by the Committee appointed in November, 1875, to inquire into the conditions and mode of administration of the annual grant of 10,000*l.* in aid of meteorological observations. That Committee consisted of the following:—Sir W. Stirling Maxwell, Chairman, Mr. T. Brassey, Mr. T. H. Farrer, Mr. Francis Galton, Mr. David Milne Home, Dr. J. D. Hooker, Mr. R. R. W. Lingen, C.B., and Lieut.-Gen. Rd. Strachey. We hope to make a few comments on the Report in our next number.

1. We have, in accordance with the Treasury Minute of November 2, 1875, made the inquiries therein mentioned. In doing so we have asked for the opinion of the President and Council of the Royal Society, who have favoured us with an elaborate report. We have also taken evidence from members and officers of the Committee which has hitherto administered the grant; and from many other persons whose opinions appeared to us to be important, either on account of their scientific eminence, their official position, or their practical knowledge and experience of the subjects in respect of which, and the classes to whom, meteorological knowledge is specially useful. To this report and evidence, which are contained in the Appendix to our Report, we desire to refer in support of the following conclusions:—

2. The business of the Committee may be considered under two heads, viz.:—

(1) The Meteorology of the Ocean.
(2) The Meteorology of the British Isles.

And the business relating to the latter of these may again be subdivided as follows, viz.:—

(*a*) That branch which by the use of the telegraph collects material for, and issues daily weather charts and storm warnings.

(*b*) That branch which collects, digests, and publishes meteorological statistics. This last branch depends on two sources of information; viz. (1) on observations taken at a limited number of stations which are provided with self-recording instruments, and which furnish continuous observations; and (2) on observations taken by the eye at stated daily periods at more numerous intermediate stations.

3. All these divisions and sub-divisions of the business have produced results of value, and should be continued. For more specific information on these points we beg to refer to the evidence, and especially to the report of the President and Council of the Royal Society.

4. Ocean meteorology should, we think, be transferred to the Hydrographical Department of the Admiralty. The reasons for this are, first, that whilst this department is equally able with the present Committee to collect observations from merchant ships, it must be better able to collect similar observations from her Majesty's ships; and, secondly, that from its experience in chartography and in nautical wants, it is specially competent to put the results in a form useful to navigators.

5. In performing this new duty the Hydrographical Department should be in such relation with the office or department which manages land meteorology, as to insure that the observations taken at sea will be so made and digested as to be available for scientific purposes in connection with those made on land.

6. Every effort should be made to act in concert with other nations in ocean meteorology, so that labour may be economised, and the utmost possible use be made of all available materials.

7. In recommending the above transfer we assume that the Lords of the Admiralty will be willing that the Hydrographical Department should undertake the duty; that that department will be organised and made in all respects adequate for the purpose; that the observations from merchant ships which have been hitherto successfully collected by the present Committee, and which are necessarily more numerous and more varied than any which can be obtained from the Royal Navy, will continue to be collected; and that the advancement of science, so far as the ocean is concerned, will be no less an object with the Hydrographical Department of the Admiralty than it has hitherto been with the present Committee.

8. As to land meteorology we have considered the alternative proposals of appointing one permanent head, as was the case before 1866, and of leaving matters to be managed by a Committee in the same manner in which they have since been managed. But we cannot recommend either of these proposals. As regards the first, although it may be desirable at some future time to create a permanant meteorological establishment on some such footing as that of the Astronomical Observatory at Greenwich, with an officer of scientific eminence at its head, we think that matters are scarcely ripe for such a step at present. As regards the second, it cannot be expected that the gentlemen who now constitute the Meteorological Committee, and who have by way of experiment given much valuable time to the work in its

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If you can afford the space I shall be glad to add a few words to the recent communications of Major Lang and Mr. Hughes to NATURE on the occurrence of *Antedon rosaceus* in Torbay.

I do not think *Antedon* has been more abundant than usual during the present year in this locality. An entry in an old note-book reminds me that a chance haul near the Thatcher Rock on July 11, 1871, brought up "plenty of feather stars," and since then during the six years I have dredged in Torbay, *Antedon* has been a very ordinary capture whilst dredging for other objects of interest.

The haul under Berry Head on July 25, alluded to by Major Lang, was undoubtedly an unusually prolific one, but had it not been for the fortunate discovery by Major Lang of the pedunculate form, the mere occurrence of an abundance of the adult feather stars would have made no impression on my mind and no notice would have been taken of it.

Remembering that the Birmingham Natural History Society had taken the young, I mentioned the fact to Major Lang, adding that I had never seen them myself. Next morning I was gratified to hear that on examining at his leisure the proceeds of the haul he had found them in quantity.

This successful result induced me to revisit the spot near the Thatcher after an interval of six years, and there, as I fully expected, *Antedon*, both adult and immature, was abundant. With this experience to guide me, I have since tried a third locality, when, though the adults were less numerous, the pedunculate young, and every stage of growth up to about an inch in diameter, appeared to me to be even more numerous than at Berry Head or the Thatcher.

In conclusion, I beg to say that it will give me pleasure to afford the fullest information in my power to any naturalist desirous of dredging in Torbay. It has often been a source of regret to me to see strangers wasting their time in dredging in spots where, as my old boatman used to say, they could not expect to meet with anything "of any consequence."

ARTHUR ROOPE HUNT

Southwood, Torquay, November 6

As the localities of *Antedon rosaceus* seem to be exciting interest, I may notice that I dredged the adult state in June, 1875, in Bressay Sound, sheltered in about 10 fathoms water, and in June, 1876, abundantly between Mount St. Edgecumbe and Duke Island, Plymouth, in about the same depth of water, in each case on a rocky bottom. PHILIP B. MASON

Burton-on-Trent, November 8

Meteor

On November 6 I observed a large meteor of a red colour. It commenced near the zenith and took a sinuous course about west-south-west, dividing into two portions after it had travelled about 40°, one portion disappearing about 10° above the horizon nearly due west, the other taking a north-west direction, and disappearing somewhat higher; it was not very bright, but seemed to be a large one. I should like to hear if anyone else has seen it; the time was between 8 and 9 P.M.

Clithero, Lancashire T. NOSTRO

THE MUSICAL ASSOCIATION[1]

THE third annual session of this Society opened on Monday, November 6, with a paper of considerable interest from Alexander J. Ellis, Esq., F.R.S., "On the Sensitiveness of the Human Ear for Pitch and Change of Pitch of Notes in Music."

It appears from the Annual Report, just issued, that the Association numbers 170 members, and is in a sound financial position. It may therefore be considered to have passed its period of infancy, and should now be permanently reckoned among the learned confederations of the metropolis.

It is not altogether uninteresting to look back at its origin and to point out the fulfilment of the especial objects for which it was established.

The first conception appears to have emanated from Mr. William Spottiswoode, Dr. Stainer, and a few other gentlemen, representing about equally the scientific and artistic sides of music, who circulated a letter among their friends, and in a private meeting held at the house of the Treasurer of the Royal Society, laid the foundations of its future organisation. The original title chosen for the new society explained at more length its peculiar objects than that which it now bears; it was "Society for the Investigation and Discussion of Subjects connected with the Art and Science of Music."

The double function herein indicated has hitherto been steadily and rigorously carried out. Indeed the Council for 1876-7, numbering among its members eminent musicians such as the two professors of Oxford and Cambridge, Messrs. Hullah, Osborne, Goldschmidt, and Dr. Stainer, is supplemented on the side of Science and Literature by the familiar names of Mr. Spottiswoode, Prof. Tyndall, Dr. Pole, Mr. W. Chappell, and Mr. George Grove.

The contributions recorded in the two annual volumes of "Proceedings" are strictly in concordance with the initial programme; they cannot be better summed up than in the words of Mr. Spottiswoode's letter above-named, advocating "the formation of a society similar in the main features of its organisation to existing learned societies. Its periodical meetings might be devoted partly to the reading of papers upon the history, the principles, and the criticism of music, partly to the illustration of such papers by actual performance, and partly to the exhibition and discussion of experiments relating to theory and construction of musical instruments, or to the principles and combination of musical sounds."

In the first year Mr. Hullah, Dr. Stainer, and Mr. Sedley Taylor, spoke on musical notation and nomenclature; Mr. Bosanquet and Mr. Ellis furnished valuable illustrations of true and tempered intonation; Mr. Charles E. Stephens criticised Dr. Day's theory of harmony; Mr. Baillie Hamilton and the writer described their respective improvements in musical instruments.

During the second session there were two papers of great value, mainly historical, from Sir F. Ouseley, "On the History of Ecclesiastical Music in Western Europe;" and from Prof. W. G. Adams "On Wheatstone's Musical Inventions," two "On Notation," by Dr. Pole and Prof. Monk; two mathematical and physiological, by Lord Rayleigh, "On Our Perception of the Direction of a Source of Sound," and Mr. Lennox Browne "On the Management of the Voice;" two mechanical and instrumental, by Mr. de Pontigny, "On Kettledrums," and by the writer "On Standards of Musical Pitch;" one critical, perhaps even polemical, by the active secretary of the Association, Mr. C. K. Salaman, "On Musical Criticism."

Several of the above communications, especially Mr. Bosanquet's two exhaustive papers "On Temperament," call for full analysis; but the general status and purpose of the Association itself are so far novel as to deserve preliminary attention. Music, of all æsthetical subjects, is that which is most deeply marked by its bisection into art and science; much of the art, little of the science is ancient; for Euclid, Pythagoras, and even Galileo carry us only a short distance into the laws of harmony. But it is peculiar to music that instruments accidentally invented, slowly improved, fabricated simply for performance, and intended solely to charm the ear, have at a later period furnished the tools and apparatus of scientific analysis. The violins of Gaspar di Salo and Straduiarius, have for centuries illustrated the laws of harmonic sounds, and even as early as the time of Tartini, furnished the *Terzo Suono*, which figures so boldly in modern acoustics.

As the instruments themselves fulfil a double purpose, so are their votaries divided into two very distinct classes, those namely of artists and theorists. The essential value of Mr. Spottiswoode's proposal lay in the appreciation of this schism, and of the means towards healing it. The

[1] Report and Proceedings of the Musical Association for 1874-5 and 1875-6.

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how it is related to the entity called matter, is no less mysterious than how subjectivity may be a property of matter. Energy moreover may be divided, Why may not subjectivity? Energy exists in isolated as well as in grouped and combined forms, Why may it not be so with subjectivity? Energy exists in a potential form when opposing forces neutralise each other—that condition of matter we call rest. May not subjectivity exist in a potential form when opposite kinds of subjective states tend to establish themselves in the same material mass—so constituting that condition of matter which we call unconsciousness? Energy is only kinetic or active, that is, only shows itself in the form best realised by us when one force has of all the others the ascendency, or is the expression of their united tendencies. May it not be so of subjectivity that it only develops into its active and best recognised form when one kind of subjective state has the ascendency, or is the expression of the united subjective states? Thus, as energy potential is rest, so subjectivity potential is unconsciousness. As kinetic energy is motion, so active subjectivity is consciousness.

In this way while all matter is subjective or susceptible of consciousness, this subjectivity seems to exist in the potential form only in all but organisms possessed of a nervous system. In the active nerve fibre the subjectivity of matter appears alone to be active or conscious, while the complex organisation of the nervous systems of the higher animals alone permits of matter rising to the powers of mind by harmoniously combining many subjective states so as to build them up into perception, understanding, memory, imagination, reason, invention, and judgment.

WM. S. DUNCAN

Stafford, November 9

Meteor

I OBSERVED from a high point overlooking the Weald, on the night of November 6, about the time Mr. Nostro mentions, a large meteor fall from a point a little below the zenith in the northern sky. It burst twice, emitting bluish sparks in doing so, once shortly before it disappeared, and the second time on its disappearing. Could it have been the same meteor seen from different positions?

I could not be positive to a point or two as to its exact magnetic bearing, but I do not think I am far wrong in saying it fell almost due north from where I observed it.

CECIL H. SP. PERCEVAL

Pulborough, November 18

THE PRESENT STATE OF MATHEMATICAL SCIENCE

AT the meeting of the Mathematical Society on November 9, Prof. H. J. S. Smith gave an address on this subject, in which he excluded all reference to applied mathematics. "I shall regard it," he said, "as a fortunate circumstance if my successor when he, in his turn, is looking round for a subject for his own presidential address, should be attracted by a domain on which I must myself decline to enter, but of which he, better perhaps than anyone among us, is fitted to give us a clear and comprehensive view." He professed to offer only fragmentary remarks, "hoping that even such fragmentary remarks may not be without their use if they serve to remind us of the vastness of our science, and yet of its unity; of its unceasing development, rapid at the present time, promising to be still more rapid in the immediate future, and yet deriving strength and vitality from roots which strike far back into the past, so that the organic continuity of its gigantic growth has been preserved throughout. In every science there is a time and place for general contemplations, as well as time for minute investigations. And it is a rule of sound philosophy that neither of these shall be neglected in its proper season ('itaque alternandæ sunt istæ contemplationes,' says Lord Bacon, 'et vicissim sumendæ ut intellectus reddatur simul penetrans et capax')."

Touching upon a charge brought against the *Proceedings* of the Society that its memoirs "have shown and still continue to show a certain partiality in favour of one or two great branches of mathematical science to the comparative neglect and possible disparagement of others," it might be rejoined "with great plausibility that ours is not a blamable partiality but a well-grounded preference. So great (we might contend) have been the triumphs achieved in recent times by that combination of the newer algebra with the direct contemplation of space which constitutes the modern geometry—so large has been the portion of these triumphs, which is due to the genius of a few great English mathematicians—so vast and so inviting has been the field thus thrown open to research, that we do well to press along towards a country which has, we might say, been 'prospected' for us, and in which we know beforehand we cannot fail to find something that will repay our trouble, rather than adventure ourselves into regions where, soon after the first step, we should have no beaten tracks to guide us to the lucky spots, and in which (at the best) the daily earnings of the treasure-seeker are but small, and do not always make a great show, even after long years of work. Such regions, however, there are in the realm of pure mathematics, and it cannot be for the interest of science that they should be altogether neglected by the rising generation of English mathematicians. I propose, therefore, in the first instance, to direct your attention to some few of these comparatively neglected spots."

The foremost place is assigned, by Prof. Smith, to the Theory of Numbers. "Of all branches of mathematical knowledge this is the most remote from all practical application, and yet, perhaps more than any other, it has kindled an extraordinary enthusiasm in the minds of the greatest mathematicians. We have the examples of Fermat, of Euler, of Lagrange, Legendre, of Gauss, Cauchy, Jacobi, Lejeune Dirichlet, Eisenstein, without mentioning the names of others who have passed away, and of some who are still living. But, somehow, the practical genius of the English mathematician has in general given a different direction to his pursuits; and it would sometimes seem as if we measured the importance of the subject by what we find of it in our best treatises of algebra, or as if we accepted the denunciations of Auguste Comte, and regarded the votaries of the higher arithmetic as reprobate of positive science, as moving in a vicious circle of metaphysical ideas, and as guilty of a great crime against humanity in the pursuit of knowledge beyond the limits of the useful. . . . I would rather ask you to listen to what is recorded of the great master of this branch of science."

Gauss (we are told by his biographer) held mathematics to be the queen of the sciences, and arithmetic to be the queen of mathematics—"She sometimes condescends to render services to astronomy and other natural sciences (so spoke the great astronomer and physicist); but under all circumstances the first place is her due." A citation was also made from Jacobi's Life of Göpel: "Many of those who have natural vocation for pure mathematical contemplation find themselves in the first instance attracted by the higher parts of the theory of numbers."

Three great departments of arithmetic were instanced: The arithmetical theory of homogeneous forms (or quantics)—"It is a memorable fact that some of the greatest conceptions of modern algebra had their origin in connection with arithmetic, and not with geometry or even with the theory of equations." In the "Disquisitiones Arithmeticæ" are given for the first time the characteristic properties of an invariant and a contravariant (for ternary quadratic forms). "But the progress of modern algebra and of modern geometry has far outstripped the progress of arithmetic; and one great problem which arithmeticians have now before them is to endeavour to turn to account for their own science the great results which have been obtained in the sister sciences. How

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dogmatic, but merely offer this as a possible assisting factor in some cases.

In towering from the second kind of injury, the bird can and sometimes does fly away from the place where it fell, and, after retrieving, concordant testimony shows lesion in the neighbourhood of the *eyes*, whence blindness has been assumed to be the cause. The fact that this very rarely occurs, perfectly agrees with the objection that the smallness of the head is adverse to the theory of cerebral injury being the invariable cause. It has further been noticed that these birds seldom move until they are touched. Whether, attention having been drawn to this subject, future observers will detect a difference in the towering of birds that may, and those that cannot, rise again, is hard to say, but I hope, in the interests of science, all pertinent observations will be communicated and admitted into the columns of NATURE.

Faringdon, Berks, December 11 J. HOPKINS WALTERS

The Tasmanians

I SEE it stated in NATURE, vol. xiv. p. 242 (which has just reached us), that M. Castelnau, French Consul at Sydney, states in a letter "to the Geographical Society of Paris, read at its last sitting, that the only four Tasmanians living were presented at the last levée held by the Governor of Tasmania."

I cannot imagine how M. Castelnau can have allowed himself to propagate such an error. It is quite true that four Tasmanian aborigines were presented at a governor's levée, but the presentation occurred just ten years ago, and all the four have long since been gathered to their fathers.

In reference to the last paragraph in your note, I regret to say that we really "have seen the last of them." The sole survivor of this singular race, a female, by name Trucanini, died a few months ago at the age of seventy or thereabouts. The "penultimate" aborigine was King Billy, who preceded Trucanini to the grave three years ago. W. W. SPICEY

Hobart Town, October 21

Algoid Swarm-spores

IN a note on algoid swarm spores, published in NATURE, vol. xv. p. 15, reference is made to the new investigations of M. Sachy, who considers the motion and accumulation of spore as due to currents produced by differences of temperature in the water, and not at all to the action of the light causing the living swarm-spores to move. I do not know the experiments by which this result has been reached; but the following seems to me a confirmation of the new theory.

At a distance of about 5 feet from the window of my room is placed a cylindrical glass vessel of 1 foot in diameter, and containing only some sphagna and microscopical crustacea. This aquarium has been kept unshaken for four years.

Now a great quantity of green alga is collected on the side opposite to the window, while the side turned towards the light is covered with a considerable number of little particles of an amorphous matter, arranged in pretty regular cloudy forms, containing nothing but *débris* of plants or animals, and a few desmidiæ.

These particles, which cannot be considered as *living matter*, arise from the light mud which covers the sand at the bottom of the aquarium. The right and left sides of the vessel remain quite clean.

I should much like to know if any of your readers have observed similar facts. E. RODIER

29, rue Saubat, Bordeaux, December 17

Meteor

I SAW the meteor spoken of by your correspondent (*ante*, p. 170) at Blackwater on Wednesday the 13th inst. at 4.45 P.M. as I was passing down St. James's Square. It was apparently of somewhat greater magnitude than the planet Jupiter, and passed from north to south, till it disappeared behind the houses.

Your correspondent will find two notices of the same meteor in the *Times* of the 15th inst. P. L. SCLATER

ON THE RELATION BETWEEN FLOWERS AND INSECTS[1]

THE habit possessed by our honey-bee of feeding itself from flowers, and its corresponding faculty of deciding amongst different species and divining the situation of the honey, is, in the first instance, derived from the common parents of all the Hymenoptera. It probably even comes from such remote ancestors as the leaf-cutting wasp, from them passes to the gall-flies, the ichneumons, and the hunting-wasps, from which latter it goes to the allied species of ants and bees. We may see all these families of Hymenoptera feeding on the honey and pollen of flowers, and manifesting a certain, if not always very obvious, intelligence in choosing the flower to be visited.

The various families of wasps differ amongst each other as to their ingenuity in finding the honey, but it is in the bees that we first arrive at the more complex use of the food, *i.e.*, not merely for the insect itself, but also for its young, combined with such intelligence in its discovery, as proves that the most highly developed form of insect is the one which profits by the honey lying most concealed. The following observations may throw some light on the foregoing statements:—

I come to the conclusion that the Hymenoptera enumerated have a certain degree of intelligence, at least with regard to honey that is in sight, from never having seen leaf-cutting wasps or ichneumons, and still less hunting-wasps or bees, seek honey so long in flowers where it does not exist as is the case with some species of beetles, which feed frequently or exclusively on the nourishment derived from flowers.

However, even very highly-organised insects are at times misled, and Dr. Müller cites one case in which *Melampyrum arvense* was surrounded by a crowd of ichneumons, bees, &c., seeking the honey in vain, the only one which succeeded in obtaining it being *Bombus hortorum*, which has the longest proboscis of all our humble-bees.

It cannot be said either of the leaf-cutting wasps or of the gall-flies that they attain a high degree of intelligence in finding concealed honey, and to these we may add the ichneumons which are frequently found on plants with the honey easily seen (Umbelliferæ, Listera, Ruta, &c.), much more rarely on those where it is partially concealed (Cruciferæ, Spiræa, Salix), and quite as an exception on those in which it is completely hidden (Gypsophila, Malva, Mentha.)

When once a family of Hymenoptera has attained to the point of intelligence of providing food for its young and placing it along with the eggs, we see it develop greater dexterity in its search for honey. In comparing, for instance, the statistics of the visits of the leaf-cutting wasp and the hunting-wasp, we find that even the most developed leaf-cutting wasp only attempts to rob those flowers whose simple form renders the honey easy of access. Even those of Bryonia and Reseda seem unattainable by them. On the contrary, we see the hunting-wasps attack not only these, but also flowers specially adapted to the movements of the fossorial Hymenoptera, for example, Echium, the Labiates, and the Papilionaceæ, and also the pendent bells of Symphoricarpus, which only allow ingress to the honey from below. It must be deduced from the above statements that flowers and the insects which visit them are adapted to each other, and have gone through corresponding degrees of development at each period of the world's history. For example, if my view of the origin of the Hymenoptera is correct, there has been a time when species with an ovipositor were the only Hymenoptera; and when only regular, open, turned-up flowers of as low a form as Salix existed, while Reseda, Echium, the Labiates, the Papilionaceæ, &c., &c., have been developed at a later period after the species of Hymenoptera had developed to the point of preparing a place for their young.

We may therefore see how through the transition of hunting-wasps to the habits of bees, and further within the bee-like family, dexterity in acquiring the food has increased. The species perhaps most nearly allied to the ancestors of the bee—Prosopis—is, as to its organisation,

[1] Abstract of an article in the *Bienen Zeitung* by Dr. H. Müller.

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